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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]Especially this invention about the device used for the method and it which dilute an undiluted solution and prepare the sample solution of predetermined dilution magnification about the automatic preparing method and automatic preparation device of a solution, For example, it applies to automatic production of the sample solution for high-frequency-induction joint plasma and a mass spectroscope (ICP-MS is called hereafter), or high-frequency-induction joint plasma-emission-spectroscopy analysis apparatus (ICP-AES), and is related with useful art.
[0002]
[Description of the Prior Art]The sample tub in which drawing 4 is an example of the overall lineblock diagram of said ICP-MS, and 1a is storing the solution under test among a figure, 1b For example, the tub which is storing a solvent like pure water, 2a, the pump with which 2b sends out a solution under test and a solvent, respectively, The controller by which 3 controls the pump 2a and the amount of sending out of 2b, the computer by which 4 sends a command signal to a controller, An atomization introducing device of the sample solution in which 5 gasifies the device under test supplied from the pump 2a and 2b and which consists of the nebulizer 500 and the spray chamber 510, The pressure regulator with which 6 adjusts a plasma torch, 7a adjusts an argon gas supply source, and 7b adjusts the pressure of argon gas, The RF generator by which 8 supplies high-frequency-induction plasma, 9 supplies a high-frequency-induction coil, and 10 supplies radio-frequency energy to said high-frequency-induction coil 9, As for a chamber, and 14, 16 and 19, a nozzle and 12 are [a secondary electron redoubling pipe and 21] signal processing parts like a microcomputer a skimmer, and 13, 15 and 18 11 a vacuum pump, a pole [like a quadrupole mass filter] whose 17 is, and 20.
[0003]In ICP-MS of this composition, the device under test gasified by the atomization introducing device 5 of the sample solution is supplied and excited by the plasma torch 6, and is ionized in an operation of the high-frequency-induction plasma 8. The ionized device under test is led to a mass spectrometer via the nozzle 11 and the skimmer 12, and quality and a quantitative analysis are carried out here.
[0004]It is the diluter of the former and Gilson as the device which prepares the sample solution under test supplied to such an analysis apparatus, i.e., a dilution

device which dilute the undiluted solution of the solution used as a device under test with pure water etc., and obtains the solution of desired dilution magnification. There is Model 401. This diluter When it prepares a sample solution under test, each publicly known dilution device of Model 401 and others leaves an undiluted solution, produces a high-concentration sample solution first, is diluted further and produces a low-concentration sample solution gradually. That is, in analyzing a sample solution generally. First For example, after analyzing by preparing a sample solution with a concentration (high concentration) of 1000 ppm, It is analyzing in the procedure of analyzing by diluting furthermore, for example, analyzing by preparing a sample solution with a concentration (inside concentration) of 50 ppm, and diluting further after that, for example, preparing a sample solution with a concentration (low concentration) of 1 ppm. It is because it is very difficult to obtain a further high-concentration sample solution from a high-concentration undiluted solution compared with this diluting a high-concentration undiluted solution gradually, and obtaining the sample solution of the concentration of a request.

[0005]

[Problem(s) to be Solved by the Invention]However, in order to produce a low-concentration sample solution under test gradually from a high-concentration sample solution under test in the above-mentioned conventional dilution device, Since many high concentration sample solutions will be measured in early stages of analysis when this dilution device is applied, for example to automatic preparation and supply of the sample solution in analysis apparatus, such as ICP-MS, There was a problem that will get the nozzle and skimmer of ICP-MS blocked, or degradation of the electronic redoubling pipe of ICP-MS will become intense, and a life will become short. In the case of what is called online equipment that adds pure water etc. to the undiluted solution of a sample solution, produces the solution of the concentration of a request, and is automatically supplied to an analysis apparatus, there was also a problem [produce / the solution of desired dilution magnification / it is impossible to get to know dilution magnification correctly, therefore / correctly] of being unknown. Since dilution magnification changed by degradation of the tube which is a channel of a solution etc. in the case of the dilution device using the peri pump as a feeding means which sends out a solution, there was also a problem that it was very difficult to set up exact dilution magnification beforehand.

[0006]This invention was made in order to solve the above-mentioned problem, and an object of this invention is to provide the automatic preparing method of the solution in which automatic production of the sample solution to high concentration [low concentration] is possible. Other purposes of this invention are to provide the dilution device using the peri pump which dilution magnification can be known correctly, and the solution of desired dilution magnification can be obtained with sufficient accuracy by it, and can set up dilution magnification still more correctly.

[0007]

[Means for Solving the Problem]An invention indicated to claim 1 uses a mixable device for a sample solution and a diluent used for dilution of this sample solution automatically at an arbitrary rate, In preparing a solution of at least two different concentration automatically continuously, a solution of concentration higher than concentration of a solution prepared last time was prepared.

[0008]Since according to this invention a low-concentration solution is left and a solution with high concentration is produced gradually, While a nozzle of ICP-MS and plugging of a skimmer are prevented by conducting analysis in ICP-MS with the application of an automatic preparing method of this solution, ephemeralization by

degradation of an electronic redoubling pipe of ICP-MS is prevented.
[0009]A diluent storage means which stores a diluent which an invention indicated to claim 2 is used for a sample solution storage means which stores a sample solution, and dilution of this sample solution, and contains an internal standard of prescribed concentration, A mixing means which mixes a sample solution and a diluent, and a sample solution feeding means which supplies a sample solution to said mixing means from said sample solution storage means, Based on concentration of an internal standard in a solution which a diluent feeding means which supplies a diluent to said mixing means from said diluent storage means, and said mixing means come to mix, a means to amend measured value based on dilution magnification of said sample solution is provided.
[0010]According to this invention, dilution magnification of a produced solution can be correctly known by measuring concentration of an internal standard in a produced solution, and amending measured value based on dilution magnification of a sample solution.
[0011]A diluent storage means which stores a diluent which an invention indicated to claim 3 is used for a sample solution storage means which stores a sample solution, and dilution of this sample solution, and contains an internal standard of prescribed concentration, A mixing means which mixes a sample solution and a diluent, and a sample solution feeding means which supplies a sample solution to said mixing means from said sample solution storage means, A diluent feeding means which supplies a diluent to said mixing means from said diluent storage means, Based on concentration of an internal standard in a solution which said mixing means comes to mix, a control means which controls at least one operation of said sample solution feeding means and said diluent feeding means is provided.
[0012]According to this invention, since operation of either a sample solution feeding means or a diluent feeding means and both is controlled based on a measured internal standard, a solution of desired dilution magnification is produced.
[0013]A sample solution storage means in which an invention indicated to claim 4 stores a sample solution, and a diluent storage means which stores a diluent used for dilution of this sample solution, The 1st mixing means that can mix a sample solution and a diluent, and a sample solution feeding means which supplies a sample solution to said 1st mixing means from said sample solution storage means, From said diluent storage means, to said 1st mixing means A diluent feeding means which can supply a diluent, The 2nd mixing means that mixes the 1st internal standard solution storage means which stores the 1st internal standard solution, and a solution which passed said 1st mixing means and the 1st internal standard solution, From said 1st internal standard solution storage means, to said 2nd mixing means The 1st internal standard solution feeding means which can supply the 1st internal standard solution, The 2nd internal standard solution storage means which stores the 2nd internal standard solution, and the 2nd internal standard solution feeding means which supplies the 2nd internal standard solution to a sample solution supplied to said 1st mixing means from said sample solution storage means, Based on concentration of the 1st internal standard in a solution which said 2nd mixing means comes to mix, and the 2nd internal standard, a means to amend measured value based on dilution magnification of said sample solution is provided.
[0014]According to this invention, dilution magnification of a produced solution can be correctly known by measuring concentration of the 1st and 2nd internal standards in a produced solution, and amending measured value based on dilution magnification of a sample solution.

[0015]A sample solution storage means in which an invention indicated to claim 5 stores a sample solution, and a diluent storage means which stores a diluent used for dilution of this sample solution, The 1st mixing means that can mix a sample solution and a diluent, and a sample solution feeding means which supplies a sample solution to said 1st mixing means from said sample solution storage means, From said diluent storage means, to said 1st mixing means A diluent feeding means which can supply a diluent, The 2nd mixing means that mixes the 1st internal standard solution storage means which stores the 1st internal standard solution, and a solution which passed said 1st mixing means and the 1st internal standard solution, From said 1st internal standard solution storage means, to said 2nd mixing means The 1st internal standard solution feeding means which can supply the 1st internal standard solution, The 2nd internal standard solution storage means which stores the 2nd internal standard solution, and the 2nd internal standard solution feeding means which supplies the 2nd internal standard solution to a sample solution supplied to said 1st mixing means from said sample solution storage means, Based on concentration of the 1st internal standard in a solution which said 2nd mixing means comes to mix, and the 2nd internal standard, a control means which controls operation of said diluent feeding means is provided.

[0016]According to this invention, since operation of a diluent feeding means is controlled based on a measured internal standard, a solution of desired dilution magnification is produced.

[0017]An invention indicated to claim 6 is characterized by each above-mentioned feeding means being a peri pump in the invention according to claim 2, 3, 4, or 5.

[0018]According to this invention, in a dilution device using a peri pump as a feeding means which sends out a solution, operation of a diluent feeding means is controlled based on an internal standard which could know dilution magnification of a produced solution correctly, and was measured. For this reason, it becomes possible to set up dilution magnification correctly beforehand.

[0019]

[Embodiment of the Invention]It explains in detail, referring to drawing 1 - drawing 3 for an embodiment of the invention below. The outline of one embodiment applied to the on-line dilution device which prepares the sample solution of desired dilution magnification automatically, and supplies the automatic preparation device of the solution concerning this invention to ICP-MS is shown in drawing 1.

[0020]The sample solution tub 100 which is a sample solution storage means in which this solution automatic preparation device stores a sample solution (undiluted solution), The 1st peri pump 105 that is a sample solution feeding means which sends out a sample solution from the sample solution tub 100, The diluent tub 110 which is a diluent storage means which stores the diluent which consists of pure water etc., The 2nd peri pump 115 that is a diluent feeding means which sends out a diluent from the diluent tub 110, The 1st connector 120 that makes the sample solution and diluent which were sent out by these 1st and 2nd peri pumps 105,115, respectively join the same channel, The mixing loop 130 which is a mixing means which uses as a uniform mixed solution the sample solution and diluent which joined by the connector 120, The 2nd connector 125 that branches the atomization introducing device 5 and the abandonment tub (depot for abandonment) 170 of a sample solution which consist of the nebulizer and spray chamber of ICP-MS, and pours the solution uniformly mixed by the mixing loop 130, The 3rd peri pump 140 that pours a sample solution from the connector 125 to the atomization introducing device 5, and the sample solution discharged from the atomization introducing device 5 The 4th peri pump 150 of

abandonment tub 170 HE ****, The abandonment tub side HE flow ******** was made to join from the sample solution sent from the atomization introducing device 5 via the peri pump 150, and the 2nd connector 125, and it has the 3rd connector 128 of abandonment tub 170 HE style **.

[0021]The control means 160 which becomes this solution automatic preparation device from the controller which controls a drive, a stop, and revolving speed of at least one rotating operation of the 1st and 2nd peri pumps 105,115, and the computer which controls that controller is established.

[0022]The channel between the sample solution tub 100 and the 1st connector 120, the channel between the diluent tub 110 and the 1st connector 120, The channel between the 2nd connector 125 and the atomization introducing device 5, the channel between the atomization introducing device 5 and the 3rd connector 128, The channel between the 2nd connector 125 and the 3rd connector 128 and the channel between the 3rd connector 128 and the abandonment tub 170 are constituted by the tube for peri pumps, etc., respectively. The flow of a sample solution and a diluent and the hand of cut of each pump are shown to drawing 1 by the arrow.

[0023]In the diluent in said diluent tub 110, the internal standard of prescribed concentration contains beforehand. And the concentration of the internal standard in the diluted sample solution is detected by ICP-MS, and rotation of one side of the 1st and 2nd peri pumps 105,115 or both is controlled by the control means 160 based on the detection result. The concentration of an internal standard is checked with the recorded value and indicated value of the output of the electronic redoubling pipe of ICP-MS, the recorder connected to ICP-MS, or a display.

[0024]The operation of the solution automatic preparation device of composition of being shown in drawing 1 is as follows. The sample solution (undiluted solution) sent out by rotation of the peri pump 105 from the sample solution tub 100, It joins via the connector 120, it is uniformly mixed with the diluent (the internal standard of prescribed concentration is included) sent out by rotation of the peri pump 115 from the diluent tub 110 via the mixing loop 130, and becomes a sample solution of predetermined dilution magnification under test. The sample solution branches to two channels via the connector 125. The sample solution which branched to the atomization introducing device side is sent to the atomization introducing device 5 by the peri pump 140, and analysis by ICP-MS is presented with it.

[0025]In that case, the concentration of the internal standard in a sample solution is also detected. And the operation of whether based on the concentration of the detected internal standard, the sample solution which was sent to the atomization introducing device 5 and with which analysis was presented had become predetermined dilution magnification is performed in the computer of the control means 160, Based on the result of an operation, rotation of one side of the 1st and 2nd peri pumps 105,115 or both is controlled to become predetermined dilution magnification.

[0026]On the other hand, the sample solution which branched to the abandonment tub side in the connector 125 joins the analyzed sample solution sent from the atomization introducing device 5 by the peri pump 150 in the connector 128, and is abandonment tub 170 HE ********.

[0027]According to the above-mentioned embodiment, the internal standard of prescribed concentration is contained in a diluent, and since the concentration of the internal standard in the sample solution which it comes to dilute with the diluent was detected, the dilution magnification of the sample solution with which analysis was presented can be known correctly. According to the above-mentioned embodiment, get to know correctly the dilution magnification of the sample solution with which

analysis was presented, and based on the value of the obtained dilution magnification by the control means 160. Since operation of one side of the peri pump 115 or both which send out the peri pump 105 which sends out a sample solution, and a diluent is controlled, the sample solution of desired dilution magnification is always obtained.
[0028]The outline of other embodiments applied to the on-line dilution device which prepares the sample solution of desired dilution magnification automatically, and supplies the automatic preparation device of the solution concerning this invention to ICP-MS is shown in drawing 2.
[0029]The sample solution tub (sample solution storage means) 100 in which this solution automatic preparation device stores a sample solution (undiluted solution), The 1st peri pump (sample solution feeding means) 105 that sends out a sample solution from the sample solution tub 100, The diluent tub (diluent storage means) 110 which stores the diluent which consists of pure water etc., The 2nd peri pump (diluent feeding means) 115 that sends out a diluent from the diluent tub 110, The 1st connector 120 that makes the sample solution and diluent which were sent out by these 1st and 2nd peri pumps 105,115, respectively join the same channel, The 1st mixing loop (the 1st mixing means) 130 which uses as a uniform mixed solution the sample solution and diluent which joined by the connector 120, The 2nd connector 125 that branches the atomization introducing device 5 and the abandonment tub 170 of a sample solution which consist of the nebulizer and spray chamber of ICP-MS, and pours the solution uniformly mixed by the mixing loop 130, The 3rd peri pump 140 that pours a sample solution from the connector 125 to the atomization introducing device 5, and the sample solution discharged from the atomization introducing device 5 The 4th peri pump 150 of abandonment tub 170 HE ****, The abandonment tub side HE flow ******** was made to join from the sample solution sent from the atomization introducing device 5 via the peri pump 150, and the 2nd connector 125, and it has the 3rd connector 128 of abandonment tub 170 HE style **.
[0030]To this solution automatic preparation device. The 1st internal standard solution sent out by the 5th peri pump 205 that is the 1st internal standard solution feeding means which sends out the 1st internal standard solution from the 1st internal standard solution tub 200 which is the 1st internal standard solution storage means which stores the 1st internal standard solution, and the 1st internal standard solution tub 200, and the 5th peri pump 205, By the 4th connector 220 made to join the sample solution which passes the 1st mixing loop 130 and is supplied to the atomization introducing device 5, and its connector 220. The sample solution and the 1st internal standard solution which joined. The 2nd mixing loop used as a uniform mixed solution. (The 2nd mixing means) With the 6th peri pump 215 and the 6th peri pump 215 which are the 2nd internal standard solution feeding means which send out the 2nd internal standard solution from 230, the 2nd internal standard solution tub 210 which is the 2nd internal standard solution storage means which store the 2nd internal standard solution, and the 2nd internal standard solution tub 210. The 3rd mixing loop 235 which uses the 5th connector 225 that makes the sample solution sent out from the sample solution tub 100 mix the 2nd sent-out internal standard solution, the sample solution which joined by the connector 225, and the 2nd internal standard solution as a uniform mixed solution is established.
[0031]The control means 260 which becomes this solution automatic preparation device from the controller which controls a drive, a stop, and revolving speed of the rotating operation of the 2nd peri pump 115, and the computer which controls that controller is established.
[0032]The 1st peri pump 105, the 3rd peri pump 140, the 4th peri pump 150, the 5th

peri pump 205, and the 6th peri pump 215 are always rotating with fixed revolving speed, while preparing the sample solution. As mentioned above, drive controlling of the 2nd peri pump 115 is carried out by the control means 260, and the revolving speed serves as variable.

[0033]Each channel between the sample solution tub 100 and the 2nd internal standard solution tub 210, and the 5th connector 225, The channel between the 3rd mixing loop 235 and the 1st connector 120, Each channel between the channel between the diluent tub 110 and the 1st connector 120, the 2nd connector 125, and the 1st internal standard solution tub 200 and the 4th connector 220, The channel between the atomization introducing device 5 and the 3rd connector 128, the channel between the 2nd connector 125 and the 3rd connector 128, and the channel between the 3rd connector 128 and the abandonment tub 170 are constituted by the tube for peri pumps, etc., respectively. The flow of a sample solution, a diluent, and each internal standard solution and the hand of cut of each pump are shown to drawing 2 by the arrow.

[0034]The concentration of the 1st and 2nd internal standards in the sample solution supplied to the atomization introducing device 5 is detected by ICP-MS, and rotation of the 2nd peri pump 115 is controlled by this solution automatic preparation device by the control means 260 based on the detection result of the 2nd internal standard. Make it rotate and stop by the control means 260, and the 2nd peri pump 115 specifically The detected strength (namely, when having added the 2nd internal standard to the sample solution) of the 2nd internal standard at the time of rotation, The dilution magnification of a sample solution is obtained by measuring the detected strength of the 2nd internal standard at the time of rotation stops (namely, when not having added the 2nd internal standard to a sample solution). About the detected strength of the 2nd internal standard, it amends with the detected strength of the 1st internal standard. It is checked with the recorded value and indicated value of the output of the electronic redoubling pipe of ICP-MS, the recorder connected to ICP-MS, or a display, the intensity, i.e., the concentration, of each internal standard.

[0035]The operation of the solution automatic preparation device of composition of being shown in drawing 2 is as follows. The sample solution (undiluted solution) sent out by rotation of the peri pump 105 from the sample solution tub 100, The 2nd internal standard solution sent out by rotation of the peri pump 215 from the 2nd internal standard solution tub 210, It joins via the connector 225 and the mixing loop 235 is mixed uniformly, and it joins via the connector 120 and is uniformly mixed with the diluent further sent out by rotation of the peri pump 115 from the diluent tub 110 via the mixing loop 130. The mixed sample solution branches to two channels via the connector 125. The sample solution which branched to the atomization introducing device side joins the 1st internal standard solution sent out by rotation of the peri pump 205 from the 1st internal standard solution tub 200 via the peri pump 140 and the connector 220, and is uniformly mixed via the mixing loop 230. The mixed sample solution is sent to the atomization introducing device 5, and analysis by ICP-MS is presented with it.

[0036]In that case, the concentration of the internal standard in a sample solution is also detected. And the operation of whether as mentioned above, based on the concentration of the detected internal standard, the sample solution which was sent to the atomization introducing device 5 and with which analysis was presented had become predetermined dilution magnification is performed in the computer of the control means 260, Based on the result of an operation, rotation of the 2nd peri pump 115 is controlled to become predetermined dilution magnification.

[0037]On the other hand, the sample solution which branched to the abandonment tub side in the connector 125 joins the analyzed sample solution sent from the atomization introducing device 5 by the peri pump 150 in the connector 128, and is abandonment tub 170 HE ********.
[0038]According to a 2nd embodiment of the above, a sample solution is made to mix the internal standard of prescribed concentration, and since the concentration of the internal standard in the sample solution which it comes to dilute with a diluent was detected, the dilution magnification of the sample solution with which analysis was presented can be known correctly. According to a 2nd embodiment of the above, the dilution magnification of the sample solution with which analysis was presented is got to know correctly, and since operation of the peri pump 115 which sends out a diluent is controlled by the control means 260 based on the value of the obtained dilution magnification, the sample solution of desired dilution magnification is obtained.
[0039]An example of the flow of the preparing method of the sample solution in the solution automatic preparation device shown in drawing 1 or drawing 2 is shown in drawing 3. In the preparing method of the sample solution concerning this invention, first, a low-concentration (for example, 1 ppm) sample solution is prepared automatically, and is supplied to analysis apparatus, such as ICP-MS (Step S1). And it is judged whether the detection limit (analysis minimum) of the analysis apparatus was exceeded (Step S2). At Step S2, when the concentration of the element of the request in "Yes, i.e., a sample solution," can be normally measured now, preparing the sample solution of step S6 HE progress and its concentration is continued, and it is continuously supplied to an analysis apparatus.
[0040]On the other hand, at Step S2, the concentration of the element of the request in "No, i.e., a sample solution," is below an analysis minimum, and when the concentration cannot be measured normally, the sample solution of inside concentration (for example, 50 ppm) is prepared automatically, and is supplied to analysis apparatus, such as ICP-MS (Step S3). And it is judged whether the detection limit (analysis minimum) of the analysis apparatus was exceeded (step S4). By step S4, when the concentration of the element of the request in "Yes, i.e., a sample solution," can be normally measured now, preparing the sample solution of step S6 HE progress and its concentration is continued, and it is continuously supplied to an analysis apparatus.
[0041]On the other hand, when the concentration of the element of the request in "No, i.e., a sample solution," is below an analysis minimum and the concentration cannot be normally measured by step S4, The high-concentration (for example, 1000 ppm) sample solution exceeding an analysis minimum is prepared automatically, and is supplied succeeding analysis apparatus, such as ICP-MS (Step S5, S6).
[0042]What is necessary is to change automatically the supply rate of the undiluted solution of a sample solution, and a diluent by the drive controlling of the peri pump by the control means 160,260, and just to make it mix in the device which shows drawing 1 or drawing 2 the concentration of the sample solution supplied to an analysis apparatus as a method of raising one by one. Or it may be made to evaporate the moisture in a mixed solution by heating the mixed solution of the undiluted solution of a sample solution, and a diluent using a heater etc.
[0043]Since according to the preparing method of this sample solution a low concentration sample is left and a sample with high concentration is gradually produced as mentioned above, For example, when conducting analysis in ICP-MS, while the nozzle of ICP-MS and plugging of a skimmer are prevented, the ephemeralization by degradation of the electronic redoubling pipe of ICP-MS is

prevented.
[0044]A solution automatic preparation device not only in the thing of composition of being shown in drawing 1 and drawing 2, It cannot be overemphasized that can change variously, if an internal standard can be mixed in the sample solution supplied to an analysis apparatus, the dilution magnification of a sample solution can be correctly known by detecting the concentration of the internal standard, it can be fed back and dilution magnification can be controlled with sufficient accuracy. For example, each feeding means which conveys a sample solution, a diluent, and each internal standard may be a pump of not only a peri pump but other forms, etc. Although it presupposed that a sample solution is produced by the concentration of a three-stage in drawing 3, it is good as two steps and the concentration of a sample solution is also as four or more steps, and it is **. This invention can be applied when preparing automatically the solution of request concentration or the solution of desired dilution magnification used for not only when preparing the sample solution for ICP-MS automatically but other analysis apparatus, and uses other than analysis.
[0045]
[Effect of the Invention]According to the invention according to claim 1, a mixable device is automatically used for a sample solution and the diluent used for dilution of this sample solution at an arbitrary rate, Since a low-concentration solution is left and a solution with high concentration is gradually produced in order to prepare the solution of concentration higher than the concentration of the solution prepared last time in preparing the solution of at least two different concentration automatically continuously, While the nozzle of ICP-MS and plugging of a skimmer are prevented by conducting analysis in ICP-MS with the application of the automatic preparing method of this solution, the ephemeralization by degradation of the electronic redoubling pipe of ICP-MS is prevented.
[0046]The sample solution storage means which stores a sample solution according to the invention according to claim 2, The diluent storage means which stores the diluent which is used for dilution of this sample solution, and contains the internal standard of prescribed concentration, The mixing means which mixes a sample solution and a diluent, and the sample solution feeding means which supplies a sample solution to said mixing means from said sample solution storage means, Since a means to amend the measured value based on the dilution magnification of said sample solution is provided based on the concentration of the internal standard in the solution which the diluent feeding means which supplies a diluent to said mixing means from said diluent storage means, and said mixing means come to mix, The dilution magnification of the produced solution can be correctly known by measuring the concentration of the internal standard in the produced solution, and amending the measured value based on the dilution magnification of a sample solution.
[0047]The sample solution storage means which stores a sample solution according to the invention according to claim 3, The diluent storage means which stores the diluent which is used for dilution of this sample solution, and contains the internal standard of prescribed concentration, The mixing means which mixes a sample solution and a diluent, and the sample solution feeding means which supplies a sample solution to said mixing means from said sample solution storage means, The diluent feeding means which supplies a diluent to said mixing means from said diluent storage means, Since the control means which controls at least one operation of said sample solution feeding means and said diluent feeding means is provided based on the concentration of the internal standard in the solution which said mixing means comes to mix, Since operation of either a sample solution feeding means or a diluent feeding means and

both is controlled based on the measured internal standard, the solution of desired dilution magnification is always produced.
[0048]The sample solution storage means which stores a sample solution according to the invention according to claim 4, The diluent storage means which stores the diluent used for dilution of this sample solution, The 1st mixing means that can mix a sample solution and a diluent, and the sample solution feeding means which supplies a sample solution to said 1st mixing means from said sample solution storage means, From said diluent storage means, to said 1st mixing means The diluent feeding means which can supply a diluent, The 2nd mixing means that mixes the 1st internal standard solution storage means which stores the 1st internal standard solution, and the solution which passed said 1st mixing means and the 1st internal standard solution, From said 1st internal standard solution storage means, to said 2nd mixing means The 1st internal standard solution feeding means which can supply the 1st internal standard solution, The 2nd internal standard solution storage means which stores the 2nd internal standard solution, and the 2nd internal standard solution feeding means which supplies the 2nd internal standard solution to the sample solution supplied to said 1st mixing means from said sample solution storage means, Based on the concentration of the 1st internal standard in the solution which said 2nd mixing means comes to mix, and the 2nd internal standard, By measuring the concentration of the 1st and 2nd internal standards in the solution produced since a means to amend the measured value based on the dilution magnification of said sample solution was provided, and amending the measured value based on the dilution magnification of a sample solution, The dilution magnification of the produced solution can be known correctly. [0049]The sample solution storage means which stores a sample solution according to the invention according to claim 5, The diluent storage means which stores the diluent used for dilution of this sample solution, The 1st mixing means that can mix a sample solution and a diluent, and the sample solution feeding means which supplies a sample solution to said 1st mixing means from said sample solution storage means, From said diluent storage means, to said 1st mixing means The diluent feeding means which can supply a diluent, The 2nd mixing means that mixes the 1st internal standard solution storage means which stores the 1st internal standard solution, and the solution which passed said 1st mixing means and the 1st internal standard solution, From said 1st internal standard solution storage means, to said 2nd mixing means The 1st internal standard solution feeding means which can supply the 1st internal standard solution, The 2nd internal standard solution storage means which stores the 2nd internal standard solution, and the 2nd internal standard solution feeding means which supplies the 2nd internal standard solution to the sample solution supplied to said 1st mixing means from said sample solution storage means, Since the control means which controls operation of said diluent feeding means is provided based on the concentration of the 1st internal standard in the solution which said 2nd mixing means comes to mix, and the 2nd internal standard, Since operation of a diluent feeding means is controlled based on the measured internal standard, the solution of desired dilution magnification is always produced.
[0050]According to the invention according to claim 6, in the dilution device using the peri pump as a feeding means which sends out a solution, operation of a diluent feeding means is controlled based on the internal standard which could know the dilution magnification of the produced solution correctly, and was measured. For this reason, it becomes possible to set up dilution magnification correctly beforehand.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a schematic diagram showing a 1st embodiment of the automatic preparation device of the solution concerning this invention.
[Drawing 2]It is a schematic diagram showing a 2nd embodiment of the automatic preparation device of the solution concerning this invention.
[Drawing 3]It is a flow chart which shows an example of the automatic preparing method of the solution concerning this invention.
[Drawing 4]It is a schematic diagram of ICP-MS.
[Description of Notations]
5 Atomization introducing device
100 Sample solution tub (sample solution storage means)
105 The 1st peri pump (sample solution feeding means)
110 Diluent tub (diluent storage means)
115 The 2nd peri pump (diluent feeding means)
120 The 1st connector
125 The 2nd connector
128 The 3rd connector
130 Mixing loop (mixing means)
140 The 3rd peri pump
150 The 4th peri pump
160,260 Control means
170 Abandonment tub
200 The 1st internal standard solution tub (the 1st internal standard solution storage means)
205 The 5th peri pump (the 1st internal standard solution feeding means)
210 The 2nd internal standard solution tub (the 2nd internal standard solution storage means)
215 The 6th peri pump (the 2nd internal standard solution feeding means)
220 The 4th connector
225 The 5th connector
230 The 2nd mixing loop (the 2nd mixing means)
235 The 3rd mixing loop

CLAIMS

[Claim(s)]
[Claim 1]A mixable device is automatically used for a sample solution and a diluent used for dilution of this sample solution at an arbitrary rate, An automatic preparing method of a solution preparing a solution of concentration higher than concentration of a solution prepared last time in preparing a solution of at least two different concentration automatically continuously.
[Claim 2]An automatic preparation device of a solution characterized by comprising the following.
A sample solution storage means which stores a sample solution.
A diluent storage means which stores a diluent which is used for dilution of this

sample solution, and contains an internal standard of prescribed concentration.
A mixing means which mixes a sample solution and a diluent.
A sample solution feeding means which supplies a sample solution to said mixing means from said sample solution storage means, A means to amend measured value based on dilution magnification of said sample solution based on concentration of an internal standard in a solution which a diluent feeding means which supplies a diluent to said mixing means from said diluent storage means, and said mixing means come to mix.

[Claim 3]An automatic preparation device of a solution characterized by comprising the following.
A sample solution storage means which stores a sample solution.
A diluent storage means which stores a diluent which is used for dilution of this sample solution, and contains an internal standard of prescribed concentration.
A mixing means which mixes a sample solution and a diluent.
A sample solution feeding means which supplies a sample solution to said mixing means from said sample solution storage means, A control means which controls at least one operation of said sample solution feeding means and said diluent feeding means from said diluent storage means based on concentration of an internal standard in a solution which a diluent feeding means which supplies a diluent, and said mixing means come to mix to said mixing means.

[Claim 4]An automatic preparation device of a solution characterized by comprising the following.
A sample solution storage means which stores a sample solution.
A diluent storage means which stores a diluent used for dilution of this sample solution.
The 1st mixing means that can mix a sample solution and a diluent.
A sample solution feeding means which supplies a sample solution to said 1st mixing means from said sample solution storage means, From said diluent storage means, to said 1st mixing means A diluent feeding means which can supply a diluent, The 2nd mixing means that mixes the 1st internal standard solution storage means which stores the 1st internal standard solution, and a solution which passed said 1st mixing means and the 1st internal standard solution, From said 1st internal standard solution storage means, to said 2nd mixing means The 1st internal standard solution feeding means which can supply the 1st internal standard solution, The 2nd internal standard solution storage means which stores the 2nd internal standard solution, and the 2nd internal standard solution feeding means which supplies the 2nd internal standard solution to a sample solution supplied to said 1st mixing means from said sample solution storage means, A means to amend measured value based on dilution magnification of said sample solution based on concentration of the 1st internal standard in a solution which said 2nd mixing means comes to mix, and the 2nd internal standard.

[Claim 5]An automatic preparation device of a solution characterized by comprising the following.
A sample solution storage means which stores a sample solution.
A diluent storage means which stores a diluent used for dilution of this sample solution.
The 1st mixing means that can mix a sample solution and a diluent.
A sample solution feeding means which supplies a sample solution to said 1st mixing

means from said sample solution storage means, From said diluent storage means, to said 1st mixing means A diluent feeding means which can supply a diluent, The 2nd mixing means that mixes the 1st internal standard solution storage means which stores the 1st internal standard solution, and a solution which passed said 1st mixing means and the 1st internal standard solution, From said 1st internal standard solution storage means, to said 2nd mixing means The 1st internal standard solution feeding means which can supply the 1st internal standard solution, The 2nd internal standard solution storage means which stores the 2nd internal standard solution, and the 2nd internal standard solution feeding means which supplies the 2nd internal standard solution to a sample solution supplied to said 1st mixing means from said sample solution storage means, A control means which controls operation of said diluent feeding means based on concentration of the 1st internal standard in a solution which said 2nd mixing means comes to mix, and the 2nd internal standard.

[Claim 6]An automatic preparation device of the solution according to any one of claims 2 to 5, wherein each above-mentioned feeding means is a peri pump.